J. Raptor Res. 31(2):129–137

THE OSPREY (*PANDION HALIAETUS*) AND MODERN FORESTRY: A REVIEW OF POPULATION TRENDS AND THEIR CAUSES IN EUROPE

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ABSTRACT.—Nearly all European Osprey (*Pandion haliaetus*) populations have had a similar fate during the 20th century. In the first two decades, if not earlier, dramatic decreases and even extirpations of many local populations occurred due to heavy persecution. There was then a recovery period until the second decrease from the 1950s to the mid-1970s, caused by DDT and other contaminants. Since then, populations have been recovering. The annual rates of population increase have varied from about 1% in Fennoscandia to about 10% in Scotland during the last 20 years. At present, 90% of all European Ospreys breed in Finland, Sweden and Russia. The nesting habitats vary widely from steep cliffs in the Mediterranean to closed climax coniferous forests, open peat bogs and large clear-cut areas in northern Europe. In some areas (e.g., Finland), cutting of old, flat-topped potential new nests by intensive commercial forestry has been the most important national threat for the local Osprey population during the last three decades. As early as the late 1960s dedicated bird banders started to construct artificial nests for Ospreys to compensate for the losses caused by one-track forestry. In 1995, 46% of all occupied Finnish Osprey nests ($N = 951$) were artificial. Also, clear-cuts around nesting trees are harmful because nests become more exposed to storms, predation by Eagle Owls (*Bubo bubo*) and disturbances. In Finland and some other countries, new guidelines for foresters also account for the welfare of the Osprey. However, the principles and practices are still quite far from each other.

KEY WORDS: *Osprey; Europe; forestry;* Pandion haliaetus; *artificial nest.*

El *Pandion haliaetus* y forestal moderno: un reviso de las tendencias de población y sus causas en Europa

RESUMEN.—Casi todas las poblaciones de *Pandion haliaetus* europeo han tenido destino similar durante el siglo viente. En las primeras dos décadas, si no mas temprano, aumentos dramáticos y también el desarrollo de muchas poblaciones local ocurrieron a causa de alta persecución. Luego hubo un tiempo de recuperación hasta la siguiente reducción de 1950s hasta el medio de 1970s, causado por DDT y otros contaminantes. Desde esos tiempos, poblaciones han estado recuperando. Los ritmos anual de aumento población han variado de 1% en Fennoscandia a casi 10% en Escocia durante los ultimo viente anos. Al presente, 90% de todo los *Pandion haliaetus* europeos se crían en Finlandia, Suecia y Rusia. Los hábitats de nidos varia muy diferente de precipicio abrupto en el mediterráneo a bosque de conifero cerrado y clímax, turbera abierto, y áreas grandes cortadas en el norte de Europa, en unas áreas (e.g., Finlandia), de potencia de nuevos nidos por intensidad comercial de forestales ha tenido lo mas importante peligro nacional para la población local de los *Pandion haliaetus* durante las tres décadas pasadas. Tan temprano como los últimos años de los 1960s marcadores de pájaros a empezaron construir nidos artificiales para el *Pandion haliaetus* para compensar la perdición causada por forestales con solo una meta. En 1995, 46% de todos los nidos de *Pandion haliaetus* ocupados en Finlandia ($N = 951$) eran artificial. También, áreas cortadas alrededor de árboles con nido eran peligrosos porque los nidos estaban mas desprotegidos a tormentas, en peligro de búho águila *Bubo bubo,* y disturbios. En Finlandia y otros países, nuevas reglas por guardabosques también cuenta por el bienestar de *Pandion haliaetus.* Sin embargo, los principios y costumbres están todavía muy lejos de cada uno.

[Traducción de Raúl De La Garza, Jr.]

The Osprey (*Pandion haliaetus*), the emblem of the former International Council for Bird Preservation (ICBP), is a suitable species as a flagship for bird protection. It is cosmopolitan and around the world has suffered heavily from several human impacts: persecution, pesticides, acid rain, disturbances, fishery practices and modern forestry (Saurola & Koivu 1987). However, it is now recov-

Table 1. Present population estimates (breeding pairs) and trends of European Ospreys.

	ESTIMATE	TREND[a]	REFERENCE
Norway	200	+	Fremming 1988, O. Steen pers. comm. 1996
Sweden	3200	+	Risberg 1990
Finland	1200	+	P. Saurola unpubl. data
Denmark	3–5	+	M. Grell pers. comm. 1996
Estonia	30–35	+	E. Tammur pers. comm. 1996
Latvia	120	+	M. Kreilis pers. comm. 1996
Lithuania	25–30	+	B. Sablevicius pers. comm. 1996
Scotland	99–105	+	R. Dennis pers. comm. 1996
Germany	290	+	Schmidt 1996
Poland	50–60	0	T. Mizera pers. comm. 1996
Belarus	120–180	+	A. Tishechkin pers. comm. 1996
European Russia	2500–4000	0(±)	V. Galushin pers. comm. 1996
Ukraine	1–5	−	Tucker and Heath 1994
Moldova	0–3	−	Tucker and Heath 1994
Bulgaria	3–6	−	Tucker and Heath 1994
France			
—mainland	6	+	Y. Tariel pers. comm. 1996
—Corsica	25	+	Y. Tariel pers. comm. 1996
Spain			
—mainland	0		C. Viada pers. comm. 1996
—Balearic Islands	16	+	C. Viada pers. comm. 1996
—Canary Islands[b]	13–15		C. Viada pers. comm. 1996
Portugal	1	−	L. Palma pers. comm. 1996

[a] Symbols: + = increasing, − = decreasing, 0 = stable, ± = in some parts of area increasing and in other parts decreasing.
[b] Canary Islands belong administratively to Spain but not geographically to Europe.

ering almost everywhere in its range, as a result of successful protection efforts. In many areas the Osprey has been classified as a species for which further monitoring and support is still necessary.

Here, I give a short review of the present distribution, population estimates, production and population trends of Ospreys in Europe. In addition, I describe the significance of human factors, especially modern forestry, to the welfare of European Ospreys. The majority of these data come from Finland where a nationwide monitoring program *Project Pandion* was started in 1971 and continues today (Saurola 1995a).

EUROPEAN OSPREYS

Historical Records. Bijleveld (1974) has collected historical records on all European birds of prey. During the 19th century, Ospreys were breeding throughout Europe. Due to heavy persecution, local populations decreased rapidly and, in many countries, they were extirpated. The last known breeding in former Czechoslovakia was recorded in about the 1850s, in Switzerland in 1911, in Great Britain and Denmark in 1916, in Austria in the 1930s, in the former West Germany in 1933 and in Italy in 1956 (Bijleveld 1974).

In the beginning of this century, the Osprey was a rare bird everywhere in Fennoscandia (Finland, Sweden and Norway). After legal protection in the 1920s in Finland and Sweden, populations slowly recovered until a new decrease occurred in the late 1950s and 1960s (Saurola 1986). This decrease was mainly due to toxic chemicals.

Present Distribution and Status. The present distribution of the European Osprey population extends from northern Norway and Finland to southern Portugal, the Balearic Islands and Corsica and from Scotland to the eastern border of the European part of Russia (Table 1). The total European population is estimated at 7000–9000 breeding pairs; about 50% of the population breeds in Sweden and Finland, 35–40% in Russia, 8% in eastern Germany, Poland, Belorus, Estonia, Latvia and Lithuania, 3% in Norway and Scotland and less than 1% in southern Europe (Table 1).

The accuracy of these population estimates var-

Table 2. Average breeding output in some local Osprey populations in Europe.

COUNTRY	PERIOD	YOUNG/ OCCUPIED NEST[a]	YOUNG/ ACTIVE NEST[a]	YOUNG/ SUCCESSFUL NEST[a]	REFERENCE
Finland	(1971–95)	1.46	1.91	2.17	Saurola this study
Sweden	(1971–93)		1.59		Odsjö pers. comm. 1996
Germany	(1972–93)				Meyburg et al. 1996
—trees		1.32	1.47	2.08	
—pylons		1.65	1.81	2.22	
Scotland	(1954–94)	1.29			Dennis 1995
Poland	(1976–92)	1.34		1.81	Mizera 1995

[a] See Postupalsky (1977) for definitions.

ies greatly from country to country, although most were provided by Osprey specialists from each country. For example, in Scotland (Dennis 1995) and Finland (Saurola 1995a) all known occupied territories have been checked annually for more than 20 yr. In contrast, the estimate for European Russia (V. Galushin pers. comm.) is based on extrapolation of information from a handful of large study areas, but still small if compared with the huge area for which the estimate is given.

Productivity and Population Trends. At the moment, all local Osprey populations breeding in northern and central Europe seem to be either stable or increasing (Table 1) and the average breeding output is good (Table 2). Definitions are according to Postupalsky (1977). Also, the remnant populations in Corsica, mainland France (Tariel pers. comm.) and the Balearic Islands (Viada pers. comm.) are now increasing, but in Portugal only one breeding pair remains (Palma pers. comm.) and in mainland Spain there are no breeding Ospreys (Viada pers. comm.). The real situation in southeastern Europe, in Ukraine, Moldova and Bulgaria is poorly known; however, all population trends from this area are negative (Tucker & Heath 1994).

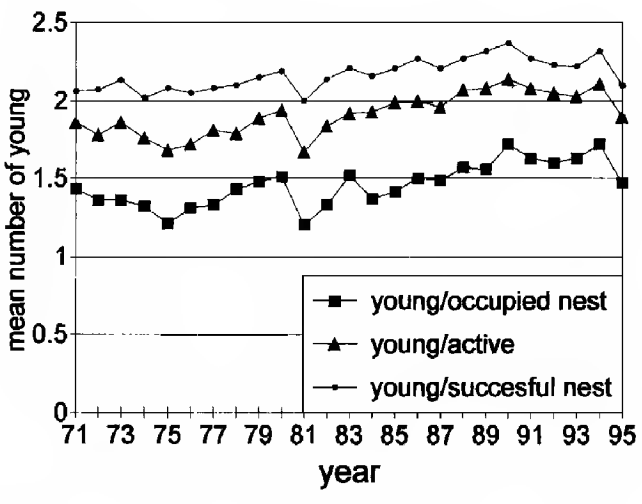

Figure 1. Average annual breeding success of Finnish Ospreys in 1971–95 (see Figure 2 for sample sizes and Postupalsky (1977) for definitions).

In Finland, *Project Pandion* was started in 1971 (Saurola 1980) and since then almost all known occupied territories have been checked by bird banders (ringers) every year. These data indicate that breeding success has increased significantly since the start of the project. During the 1970s, Finnish Ospreys raised on average 1.38 young/occupied nest/year, but during the 1980s and 1990s, the corresponding figures have been 1.47 and 1.61. The trend for these three decades is similar in production per occupied (1.81, 1.96 and 2.03) and per successful nests (2.09, 2.21 and 2.23; Fig. 1).

According to all data from *Project Pandion,* the Finnish Osprey population remained stable through the 1970s and then increased during the 1980s and 1990s (Table 3, Fig. 2). A part of this increase, especially in sparsely inhabited northern Finland, may be only a result of increasing survey coverage. In Häme, southern Finland, where my intensive study area is located and where few, if any, nests are not known by *Project Pandion,* the increase rate in 1972–1995 has been 0.7% per year. This is considerably less than the 2% per year calculated from all data for the whole country (Table 3). My estimate for the real growth rate of the total Finnish Osprey population during the last 25 yr is between 1% and 1.5% per yr.

Swedish Ospreys have been monitored at six study areas located in southern and central Sweden. These areas have been carefully checked in 1971–73 and after that every 5th yr in 1978, 1983, 1988 and 1993 (Odsjö pers. comm.). The average

Table 3. Mean annual rate of population increase of the Osprey in some European study areas.

	Period	Change		Increase per Year[c]	Reference
		N_1[a]	N_2[b]		
Finland (active nests)					
—all known	1972–95	465	736	2.0%	Saurola, this study
—Häme	1972–95	94	110	0.7%	Saurola, this study
Sweden (active nests)					
—6 study areas	1972–93	97	113	0.7%	Odsjö 1982 and pers. comm. 1996
Germany (pairs)					
—Mecklenburg	1980–93	62	94	3.3%	Meyburg et al. 1996
—Brandenburg	1980–92	45	120	8.5%	Meyburg et al. 1996
Scotland (pairs)					
—all known	1977–95	20	99	9.3%	Dennis 1987 and pers. comm. 1996

[a] N_1 = number of active nests or pairs in the first year of study period.
[b] N_2 = number of active nests or pairs in the last year of study period.
[c] Mean increase per year (p) was calculated from the formula: $N_2 = N_1(1 + p/100)^t$, where t = elapsed time in years.

annual increase during the last 20–25 yr within these study areas has been 0.7%, which is the same as in Häme, but much lower than in Germany and Scotland (Table 3). So far, no clear explanation has been proposed for these geographic differences in rates of population increase (Saurola 1990, 1995a).

Migration and Wintering Areas. European Ospreys migrate to the tropics (Österlöf 1977, Dennis 1991, Saurola 1994), except for the Mediterranean populations, which remain in the Mediterranean (Thibault et al. 1987). The main wintering area is the Sahel-zone between latitudes 5–15°N. Band recoveries revealed longitudinal differences in wintering areas of the local populations from different parts of the breeding range: Scottish Ospreys winter along the west coast of Africa (Dennis 1991), Swedish birds mainly in inland waters of west Africa and the Finnish ones still further east, in west and central Africa (Österlöf 1977, Saurola 1994). So far, only four banded European Ospreys have been recovered from South Africa, about 10 000 km from their natal area, all of Finnish origin.

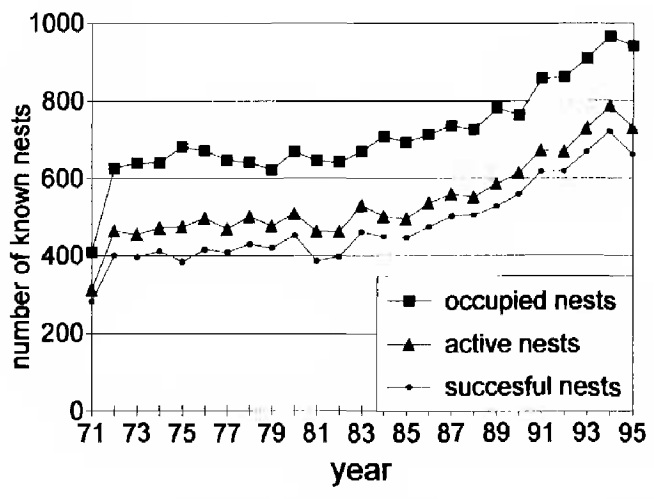

Figure 2. Total number of known occupied (squares), breeding (triangles) and successful (dots) Osprey nests in 1971–1995 in Finland (see Postupalsky (1977) for definitions).

In the late 1970s, a detailed study on the winter ecology of European Ospreys was made in Senegambia (Prevost 1982).

Nesting Habitats and Nest Sites. The Osprey eats live fish almost exclusively (e.g., Häkkinen 1977, 1978, Saurola & Koivu 1987) and for this reason its distribution is always restricted by the distribution of favorable fishing waters. In ideal conditions the nest is located just at the shoreline. However, in areas disturbed by human activities, the distance from the nest to the fishing grounds may be several km.

In addition to sufficient food resources, the most important prerequisite of a good nest site is a stable and exposed base to support the nest. Because the Osprey nest has to be exposed to all directions, it is nearly always at the very top of the tree and no branches reach the upper edge of the nest. There are few exceptions from this general rule. The nesting habitat and the base of the nest can be varied if the two main requirements are filled. More than 95% of European Ospreys breed in forested habitats (coniferous forests or on peat bogs). The cliff-nesting birds in Corsica (Terasse and Ter-

asse 1977), the Balearic Islands (González et al. 1992) and in Portugal (L. Palma pers. comm.), and pairs nesting on power line pylons in the middle of open fields in Germany (Moll 1962) are the only exceptions to this general pattern. The successional stage, structure and openness of the forests around the nest varies from closed climax coniferous or mixed forests to clear-cuts where the nest tree is the only one left. One of the favorite natural sites is a small islet in a lake covered by big trees.

The most common nesting tree species both in European forests and peat bogs is the Scotch pine (*Pinus silvestris*). For example, this tree species hosts 88% of natural nests in Finland. In this species the structure of the flat top of an old tree provides a stable base for the huge stick nest of the Osprey. Norwegian spruce (*Picea abies*) is the next most commonly utilized tree species (3% in Finland), and broad-leaved trees (e.g. *Betula, Populus, Alnus, Quercus*) are rarely used as nesting trees by European Ospreys (only 1% in Finland). A total of 7% of natural Osprey nests are on dead trees in Finland. Norwegian spruce is suitable for the Osprey only if the top has been broken some meters from the tip, so that the branches are thick enough to carry the heavy nest. In Scotland, about one-quarter of the nests are now on an introduced species, Douglas fir (*Pseudotsuga menziesii*) with broken tops (Dennis pers. comm.).

HUMAN IMPACT

Persecution. Birds of prey were heavily persecuted throughout Europe as early as the 17th century. This persecution intensified during the 18th century and peaked in the 19th and early 20th centuries (Bijleveld 1974). For more than 200 yr, millions of birds of prey were killed because they were considered harmful pests. During World Wars I and II, hunters were allowed to shoot each other, so killing of birds of prey decreased. Immediately after World War II, intensive persecution resumed. For example, in autumn 1953 at least 93 Ospreys were killed at three fishponds in Lower Saxony (Bijleveld 1974).

The Osprey has been legally protected since 1926 in Finland (Saurola & Koivu 1987) and since the late 1920s in Sweden (Österlöf 1973). In many other European countries full legal protection was given to the Osprey less than 40 yr ago, for example, in Denmark in the 1950s, Poland in 1952, United Kingdom in 1954, former East Germany in 1954, Norway in 1962, France in 1964, former USSR in 1964 (enforced in 1974), Spain in 1966, former West Germany in 1968 and Italy in 1971 (Bijleveld 1974).

Legal protection does not necessarily mean that killing ceases. Saurola (1985a, 1994) attempted to assess changes in persecution of Fennoscandian Ospreys in Europe and Africa by calculating area-specific persecution indices from band recoveries. This analysis, which might be biased by changes in reporting rates, suggested that persecution decreased in Italy, France and in the former USSR in the 1970s after changes in legislation. In contrast, killing of Ospreys in Africa has remained the same during the last 30 yr.

In addition to being killed as a competitive consumer of fish, European Ospreys have suffered from illegal egg and skin collecting. In Scotland, egg robbing still continues, perhaps at least partly as a challenging game against police and conservation authorities. For example, in 1988 and 1989, 11 and 9 out of 49 nests were robbed in Scotland, respectively (Dennis 1991).

Pesticides. In the late 1940s and 1950s, when persecution increased again after World War II, DDT and other environmental contaminants appeared as a new threat to the future of the Osprey and other birds of prey all over the world (Poole 1989). Odsjö (1982) found that eggshell thickness of unhatched Swedish Osprey eggs was 11% lower than that of shells collected before DDT was first in use in 1947. In nests where all eggs were broken, eggshell thickness was 20% lower than in pre-DDT eggs, and, as expected, breeding success had decreased from the pre-DDT level.

In Finland, during *Project Pandion,* all addled eggs have been collected and DDT, DDD, DDE and total PCB concentrations have been analyzed but not yet published. Preliminary results show that DDT concentrations in Finnish Osprey eggs have decreased significantly during the last 20 yr. Moreover, even in the early 1970s the concentrations were much lower than in Swedish eggs (Odsjö 1982).

Acidification of Lakes. Eriksson et al. (1983) and Eriksson (1986) suggested that reduced breeding success of the Osprey in southwestern Sweden was due to higher nestling mortality caused by reduced foraging success in acidified lakes. They predicted that a population decrease would occur as a consequence of more widespread acidification. So far, no further evidence of the negative effects of acid-

ification on European Osprey populations has been published.

Fishing and Fish Farms. Of Finnish band recoveries (returns) of dead Ospreys in 1950–1987, 29% were found dead with no more information; while of the remainder, 53% were shot or otherwise killed intentionally, 25% were entangled in a fishing net and 10% were hit by overhead wires (Saurola & Koivu 1987). Although the distribution of causes of death assessed from ring recoveries is biased, it clearly demonstrates that fishing is an important factor. In Finland, the most dangerous period for Ospreys is early spring when most of the fishing grounds are still covered by ice. At this time Ospreys are caught in nets in small areas of open and shallow water exploited both by Ospreys and by fishermen.

In Finland, at commercial fish farms growing North American rainbow trout (*Oncorhynchus mykiss*), Ospreys have been killed both by illegal shooting or by poorly placed strings or nets set to protect trout. At the moment, most Finnish fish farms are safe for Ospreys because the state pays compensation to the owners from damages caused by Ospreys.

Illegal shooting of Ospreys at fish farms is still a problem at least in Poland (Mizera 1995) and probably in other countries in eastern Europe.

Land Use and Disturbances. In Finland, about 15% of the present nest sites of the Osprey are close to the shoreline (*Project Pandion*). The main reason for this unexpectedly low proportion is land use because the dream of every Finn is to have a summerhouse by a lake or in the Baltic archipelago. Hence, there is little shoreline left for Ospreys. In many cases the historic nest sites have been abandoned and Ospreys have moved to the middle of forests, often several kilometers away from their historic nest sites.

After the persecution and pesticide eras in the 1980s, human disturbances (fishing, canoeing, sailing and bathing) became the major threats to the species in Swedish lake areas, where many Ospreys still bred close to the shore (Odsjö & Sondell 1986).

OSPREYS AND MODERN FORESTRY

Modern forestry may have four kinds of negative effects on the welfare of the Osprey: cutting of occupied nest trees, cutting of potential alternative nest trees, cutting of trees from the protection zone around the nest and noise disturbance from forestry activities in the neighborhood of the nest during the breeding season.

Cutting of Occupied and Potential Alternative Nest Trees. The Osprey is fully protected by national laws in those European countries which have breeding Ospreys (Bijleveld 1974). Consequently, the occupied nest trees should be protected during the breeding season throughout Europe. In contrast, during the nonbreeding season the nests and nesting trees are not protected in all European countries. Hence, in some countries the nest tree can legally be cut after the breeding season, even though this nest tree would likely be used again the following summer if left intact.

The same Osprey nest may be in use for decades (Saurola & Koivu 1987) and for this reason it is crucial to protect the nest tree all year. However, the protection of an occupied nest tree is not enough because of the evolution of the top of an Osprey nest tree. The Osprey brings new sticks to the nest every year, the nest grows higher and higher, and finally falls down. After this the top of the tree usually is not of sufficient quality to serve as a base for the nest. Thus, within each territory, a sufficient number of old, flat-topped nest trees should be saved as alternative nest trees for the future.

Cutting of Trees from the Protection Zone Around the Nest. If all trees around the nest tree are removed, the probability of a breeding failure increases for several reasons. First, a solitary tree is much more exposed to damage caused by storms. Second, a tall tree in a clear-cut is an ideal hunting perch for the Eagle Owl (*Bubo bubo*), which is mainly an open-land hunter (Mikkola 1983). Thus, the probability is high that a hunting Eagle Owl will locate and kill an incubating or brooding Osprey or the entire brood. Moreover, the fledged young are especially vulnerable because they use their nest as a perch for eating for 4 wk after fledging (Saurola & Koivu 1987). The noisy begging of the young at sunset from the middle of a clear-cut is like a dinner bell for an Eagle Owl starting to hunt. In Finland, where the Eagle Owl population has been increasing rapidly during the last decades (Saurola 1985b, 1995b) and where many of the Osprey nest sites have been classified as clear-cuts or other types of open forests (22% in 1995, *Project Pandion*), more and more Osprey nests have been predated by Eagle Owls. Third, it is clear that the disturbance zone of many activities (e.g., forestry, recreation, sports) around the nest is wider in open clear-cuts than in closed forests.

Forestry Activities Near the Nest During Breeding. According to the 26-yr data from *Project Pandion*, inappropriate timing of forestry work in the neighborhood of the nest has caused several breeding failures in Finland. These failures have been demonstrated as results of construction of logging roads, digging ditches, harvesting, improving of young stands and planting seedlings.

A Promising Example for a Better Future: Guidelines by the Finnish Forest and Park Service. Finnish Forest and Park Service (1994) has recently published the new guidelines for all activities near the Osprey nests for land owned by the government. The main points of these guidelines are that the nest tree is protected all year under the Nature Conservation Act, a protective tree stand (density 200 stems/ha) must be left around the nest for a radius of approximately 50 m, a bog surrounding a clump of trees in which there is an Osprey nest must be left in a natural state, any forestry activities must be avoided close to the nest in the period 15 April–31 July, old Scotch pines and saw timber trees must be left in clumps for future development into ideal nest sites and paths and hiking routes must not be established within about 500 m from the nest. Almost identical advice has been given by the Forestry Center Tapio (1994) for the management of Osprey nest sites on private land.

These guidelines for state-owned and private lands are sufficient for the protection of Finnish Ospreys. In practice, these guidelines, especially on private lands, are only recommendations and therefore not always followed by foresters. For example, clear-cuts still occur around nest trees and seedlings are planted close to active nests during sensitive periods in the breeding season.

In some countries the guidelines are even more strict than in Finland. For example, in Poland no trees are allowed to be cut within 200 m from the nest and during the breeding season (1 February–31 July), all forestry activities are forbidden within 500 m from the nest (Mizera 1995). In many other European countries, guidelines for forestry near nest sites of endangered or rare birds, such as eagles and Ospreys, are under changes or in preparation. For example, in the eastern states of Germany, old, and often very strict, regulations are no longer officially enforced but are still in practice because new ones are not yet available (D. Schmidt pers. comm.). Hence, it is difficult to make an overall European summary of this subject.

Artificial Nests. Construction of artificial nests has been the only possible direct measure to compensate for the effects of one-track commercial forestry. In Finland, the first artificial nests for Ospreys were constructed in 1965 (Saurola 1978). In 1995, 45.8% of all occupied nests in Finland were artificial (*Project Pandion*). In my intensive study area in southern Häme, the percentage of artificial nests was as high as 90% of 79 occupied nests. I have estimated that in this area which, without intensive modern forestry, would be an ideal natural area for the Osprey, the population would be less than 50% of the present level without artificial nests (in total 160 artificial nests are available for the Osprey in this area).

Meyburg et al. (1996) have demonstrated that, in Germany, breeding output was clearly higher in artificial nests on power line pylons than in natural tree nests within the same area (Table 2). However, in Finland, no difference in breeding success between artificial and natural nests was detected (Saurola 1990). This perhaps unexpected result was probably because most of the unstable natural nests were replaced by artificial nests. Therefore, artificial nests were not compared with normal natural nests but with high quality natural nests.

In Europe, artificial nests have been constructed during the 1980s and 1990s in almost all countries with breeding Ospreys and in most cases with good success. For example, soon after artificial nests were provided in southern Norway, Ospreys started to expand their range westward back to their historic breeding sites, where the number of suitable nest trees had greatly decreased because of forestry (Steen 1993). In Sweden, artificial nests have been constructed to move Ospreys from disturbed areas to undisturbed areas with good results (Hallberg et al. 1983).

CONCLUDING REMARKS

During the last 10 yr, local Osprey populations in northern and central Europe have been stable or are still recovering from the effects of persecution and organochlorine pesticides. These two threats are currently not major problems in Europe but still may be so in Africa.

In contrast, both past and present effects of modern forestry may be an important negative factor for the Osprey. In addition to the lack of suitable nest trees in some areas, many breeding failures are due to modern forestry, either directly (forestry activities near the nest during the breed-

ing season) or indirectly (nests on the open clear-cuts are more exposed to storms, Eagle Owls and disturbances).

Official silvicultural guidelines are important for the protection of traditional nest sites of Ospreys in commercially treated forests. Instructions for management of Ospreys have been provided in some countries for foresters. In some others, such as the former socialist countries in eastern Europe, the new guidelines are under preparation.

Construction of artificial nests has been an effective tool to compensate for some of the effects of modern forestry. However, the extensive protection of natural nest trees and their surroundings should always be the primary long-term goal. Construction of artificial nests should be used as the last and temporary measure to save or reintroduce local populations, but never as an excuse to destroy natural breeding sites.

ACKNOWLEDGMENTS

The invitation from Gerald Niemi made this contribution possible. Unpublished information on present status of the Osprey in Europe is based on personal communications with Roy Dennis, Vladimir Galushin, Mikael Grell, Maris Kreilis, Tadeuz Mizera, Tjelvar Odsjö, Luis Palma, Bronius Sablevicius, Odd Frydenlund Steen, Einar Tammur, Yvan Tariel, Alexey Tishechkin and Carlota Viada. Finnish data is from *Project Pandion,* a monumental voluntary work by Finnish bird ringers. Previous draft of this paper was reviewed by Peter Evins, Charles Henny, Mikael Kilpi and Daniel Varland. I am very grateful to all these people for their valuable help.

LITERATURE CITED

BIJLEVELD, M. 1974. Birds of prey in Europe. MacMillan Press Ltd., London, U.K.

DENNIS, R. 1991. Ospreys. Colin Baxter Photography Ltd., Lanark, Scotland.

———. 1995. Ospreys *Pandion haliaetus* in Scotland—a study of recolonization. *Vogelwelt* 116:193–196.

ERIKSSON, M.O.G. 1986. Fish delivery, production of young, and nest density of Osprey (*Pandion haliaetus*) in southwest Sweden. *Can. J. Zool.* 64:1961–1965.

———, L. HENRIKSON AND H.G. OSCARSON. 1983. Försurning—ett framtida hot mot fiskgjusen (*Pandion haliaetus*) (Summary: Acid rain—a future danger for the Osprey, *Pandion haliaetus*). *Vår Fågelvärld* 42:293–300.

FINNISH FOREST AND PARK SERVICE. 1994. Forestry environment guide. Tuokinprint, Helsinki, Finland.

FORESTRY CENTER TAPIO. 1994. Good forests for the good of all. Helsinki, Finland.

FREMMING, O.R. 1988. Fiskeørn—bestand økologi og forvaltning (Summary: The osprey—population, ecology and conservation). *Økoforsk utredning* 20:1–70.

GONZÁLEZ, G., J.M. SANTIAGO AND L. FERNÁNDEZ. 1992. El aguila pescadora (*Pandion haliaetus*) en España. (In Spanish with English summary.) ICONA, Madrid, Spain.

HALLBERG, L.-O., P.-S. HALLBERG AND J. SONDELL. 1983. Styrning av fiskgjusens *Pandion haliaetus* val av boplatser i Helgasjön, Kronobergs län, för att minska störningsrisken (Summary: Changing the location of nest sites of the Osprey, *Pandion haliaetus,* to reduce human disturbance). *Vår Fågelvärld* 42:73–80.

HÄKKINEN, I. 1977. Food catch of the Osprey *Pandion haliaetus* during the breeding season. *Ornis Fenn.* 54: 166–169.

———. 1978. Diet of the Osprey *Pandion haliaetus* in Finland. *Ornis Scand.* 9:11–116.

MIKKOLA, H. 1983. Owls of Europe. T. & A.D. Poyser, Calton, U.K.

MIZERA, T. 1995. Why is the Osprey *Pandion haliaetus* a rare breeding species in Poland? *Vogelwelt* 116:197–198.

MEYBURG, B.-U., O. MANOWSKY AND C. MEYBURG. 1996. The Osprey in Germany: its adaptation to environments altered by man. Pages 125–135 *in* D.M. Bird, D.E. Varland and J.J. Negro [EDS.], Raptors in human landscapes. Academic Press, London, U.K.

MOLL, K.H. 1962. Der Fischadler. (Osprey, in German). Die Neue Brehm Bücherei 308. A. Ziemsen Verlag, Wittenberg Lutherstadt, G.D.R.

ODSJÖ, T. 1982. Eggshell thickness and levels of DDT, PCB and mercury in eggs of Osprey (*Pandion haliaetus* L.) and Marsh Harrier (*Circus aeruginosus* L.) in relation to their breeding success and population status in Sweden. Ph.D. dissertation, Univ. of Stockholm, Gotab, Stockholm, Sweden.

——— AND J. SONDELL. 1986. När och hur bör fiskgjusen skyddas (Summary: When, and in what way, is the Osprey to be protected)? *Vår Fågelvärld* 45:351–358.

ÖSTERLÖF, S. 1973. Fiskgjusen, *Pandion haliaetus,* i Sverige 1971 (Summary: The osprey *Pandion haliaetus* in Sweden in 1971). *Vår Fågelvärld* 32:100–106.

———. 1977. Migration, wintering areas, and site tenacity of the European Osprey *Pandion h. haliaetus* (*L.*). *Ornis. Scand.* 8:61–78.

PREVOST, Y. 1982. The wintering ecology of Ospreys in Senegambia. Ph.D. dissertation, Univ. of Edinburgh, Edinburgh, Scotland.

POOLE, A.F. 1989. Ospreys: a natural and unnatural history. Cambridge Univ. Press, Cambridge, U.K.

POSTUPALSKY, S. 1977. A critical review of problems in calculating Osprey reproductive success. Pages 1–11 *in* J.C. Ogden [ED.], Transactions of the North American Osprey research conference. U.S. Nat. Park Ser., Transac. and Proceed. No. 2.

RISBERG, L. 1990. Sveriges fåglar. *Vår Fågelvärld,* supplement No. 14.

SAUROLA, P. 1978. Artificial nest construction in Europe. Pages 72–80 *in* T.A. Geer [ED.], Bird of prey manage-

ment techniques. The British Falconers' Club, Pachment Ltd., Oxford, U.K.

———. 1980. Finnish *Project Pandion*. *Acta Ornithol.* XVII: 161–168.

———. 1985a. Persecution of raptors assessed by Finnish and Swedish ring recovery data. Pages 439–448 *in* I. Newton and R.D. Chancellor [EDS.], Conservation studies on raptors. ICBP Tech. Publ. No. 5., Norwich, England, U.K.

———. 1985b. Finnish birds of prey: status and population changes. *Ornis Fenn.* 62:64–72.

———. 1986. Viisitoista vuotta Suomen sääksikannan seurantaa (Summary: The Ospreys, *Pandion haliaetus*, in Finland 1971–1985). *Lintumies* 21:66–80.

———. 1990. Sääksi—suojelun ja seurannan symboli (Summary: The Osprey—symbol of bird protection and monitoring). *Lintumies* 25:80–86.

———. 1994. African non-breeding areas of Fennoscandian Ospreys *Pandion haliaetus*: a ring recovery analysis. *Ostrich* 65:127–136.

———. 1995a. Finnish Ospreys *Pandion haliaetus* in 1971–1994. *Vogelwelt* 116:199–204.

———. 1995b. Suomen pöllöt (Summary: Owls of Finland). Kirjayhtymä, Helsinki, Finland.

——— AND J. KOIVU. 1987. Sääksi. (Osprey, in Finnish) Kanta-Hämeen Lintumiehet, Forssa, Finland.

SCHMIDT, D. 1996. Brutbestand und verbreitung des Fischadlers *Pandion haliaetus* in Deutschland—eine aktuelle Kurzübersicht (Summary: Breeding numbers and distribution of the Ospreys *Pandion haliaetus* in Germany—a short review). *Vogelwelt* 117:337–340.

STEEN, O.F. 1993. Fiskeørn i Vestfold i perioden 1984–89. (Summary: Osprey *Pandion haliaetus* in Vestfold county, SE-Norway, during the period 1984–1989) *Fauna* 46:150–165.

TERASSE, J.-F. AND M. TERASSE. 1977. Le Balbuzard pêcheur *Pandion haliaetus* (L.) en Mediterranée occidentale. Distribution, essai de recensement, reproduction, avenir. (In French, with English summary.) *Nos Oiseaux* 34:111–127.

THIBAULT, J.-C., O. PATRIMONIO AND D. BRUNSTEIN-ALBERTINI. 1987. Sedentarite et mouvements des balbuzards pecheurs (*Pandion haliaetus*) de la Corse. Pages 253–260 *in* N. Baccetti and M. Spagnesi [EDS.], Rapaci Mediterranei, III, Suppl. Ric. Biol. Selvaggina, XII. Bologna, Italy.

TUCKER, G.M. AND M.F. HEATH. 1994. Birds in Europe: their conservation status. BirdLife International, Cambridge, U.K.